

Space Weather Technical Forecast

Issued on Monday 20 January 2025 at 13:29 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: M-class flares expected, with a slight chance of X-class flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Low, with a peak C8.2 flare at 19/1708 UTC from AR3959. AR3961, located near the central meridian in the southern hemisphere remains the largest sunspot on the disc with occasional low-level C-class flare activity. Some slight increase in penumbral growth was observed, but also slight decay in its main trailer spot. Despite its size it maintains a fairly simple magnetic configuration. A weak delta spot in the interior of the same group emerged and then largely decayed. AR3959, in the northwest, persisted with a large leader spot and strong magnetic field, but just limited small opposite polarity spots to its east and northeast and a relatively simple magnetic structure. AR3964 was responsible for some low-level C-class activity and remains moderately complex, however, became increasingly foreshortened in coronagraph imagery as it approached the western limb. AR3968 in the far southwest, underwent slight development, but also became harder to view. Elsewhere, small sunspot groups emerged in the eastern disc, including AR3969 and AR3970, as well as another small region in the northeast, resulting in a cluster of four sunspots. The remaining regions on the disc are small and magnetically simple.

Disappearing filaments in the southeast disc around 19/2300 UTC and 20/0515 UTC were observed in coronagraph imagery, however, no definitive CMEs were in evidence following either event. Therefore no clear Earth-directed CMEs have been observed.

Solar Wind / Geomagnetic Activity: Ongoing fast winds from CH09/- were observed. Solar wind speed, as measured by ACE and DSCOVR increased from slightly elevated to strong levels, reaching 600-650km/s by the end of the period. Density was at or below average. Interplanetary Magnetic field, Bt, was Weak to Moderate, ranging from 5-10nT, with the north-south component varying between +9/-8nT, with no single orientation favoured. Phi angle was mainly negative (towards the Sun). Geomagnetic activity was Quiet to Active (Kp2-4).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) at GOES18 was at Background. High energy electron flux (greater than 2MeV) at GOES16 was mainly Moderate, peaking 791pfu at 19/1845UTC. The associated 24-hour fluence persisted below the Active threshold, reaching 2.32e7 integrated pfu at 20/0000UTC.

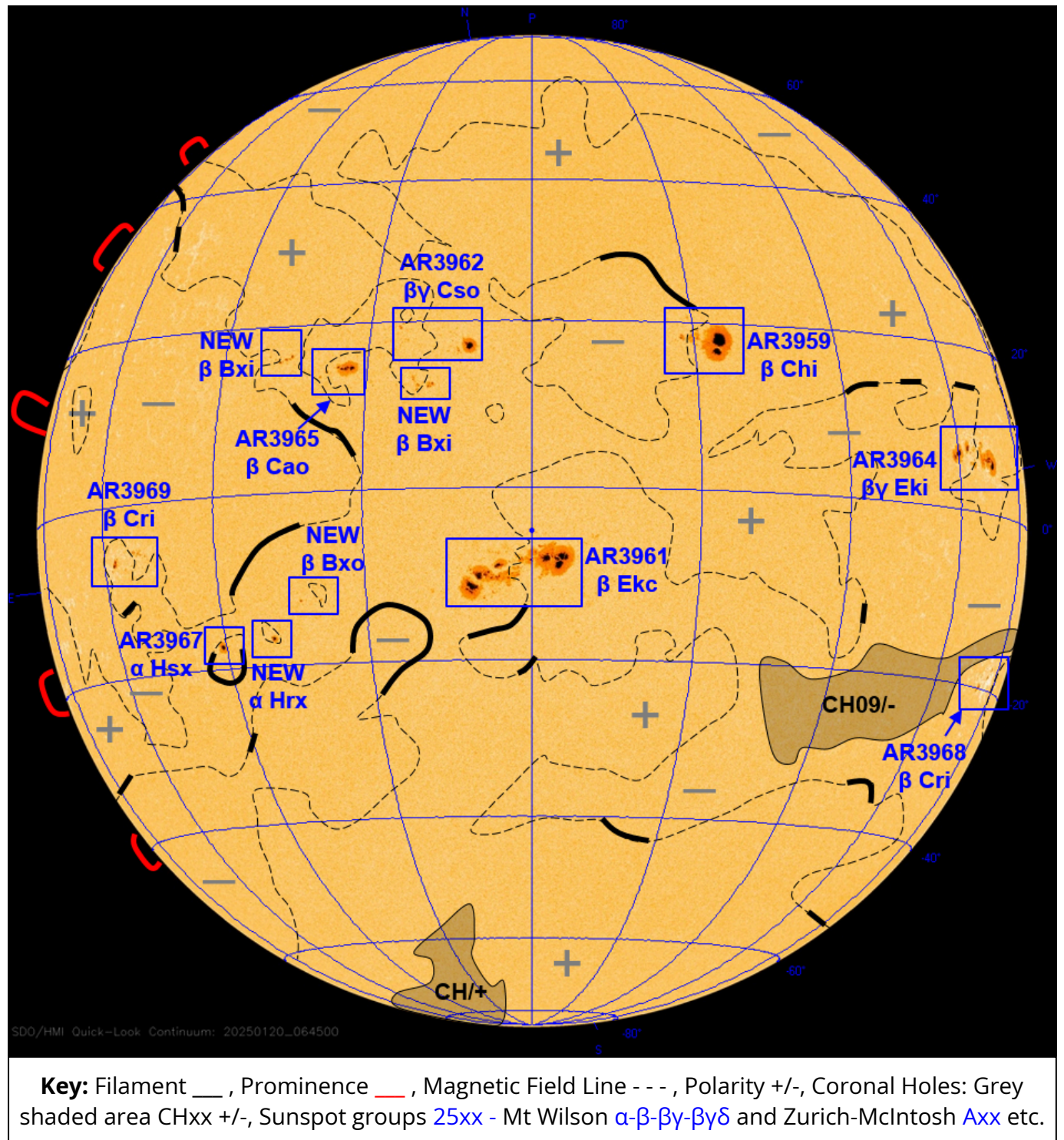
Four-Day Space Weather Forecast Summary

Solar Activity: Moderate activity is forecast, with isolated M-class flares expected and a slight chance of X-class flares.

Solar Wind / Geomagnetic Activity: There are no CME arrivals expected at Earth, however a glancing impact from the CME early on 18 Jan cannot be completely ruled out late on Day 1 (20 Jan) or early Day 2 (21 Jan). Otherwise, current strong fast winds from CH09/- are expected to continue before gradually easing from Day 2 (21 Jan) onward, likely becoming near background by the end of Day 4 (23 Jan). Mainly Quiet to Unsettled geomagnetic activity is expected, with a chance of Active intervals, these most likely on Day 1 and 2 (20 and 21 Jan).

Energetic Particles / Solar Radiation: GOES18 high energy proton flux is expected to be at Background, but with a slight chance of enhancements exceeding the S1 Minor Radiation Storm threshold should any notable flares occur. GOES16 high energy electron flux is forecast to be Moderate, perhaps peaking at High, although the longevity of the periods of High is low confidence. The associated 24 hr fluence is expected to remain below the Active threshold (1e8 integrated pfu).

Figure 1: MOSWOC Solar Synoptic Map valid 20/0645 UTC.



Geomagnetic Storms

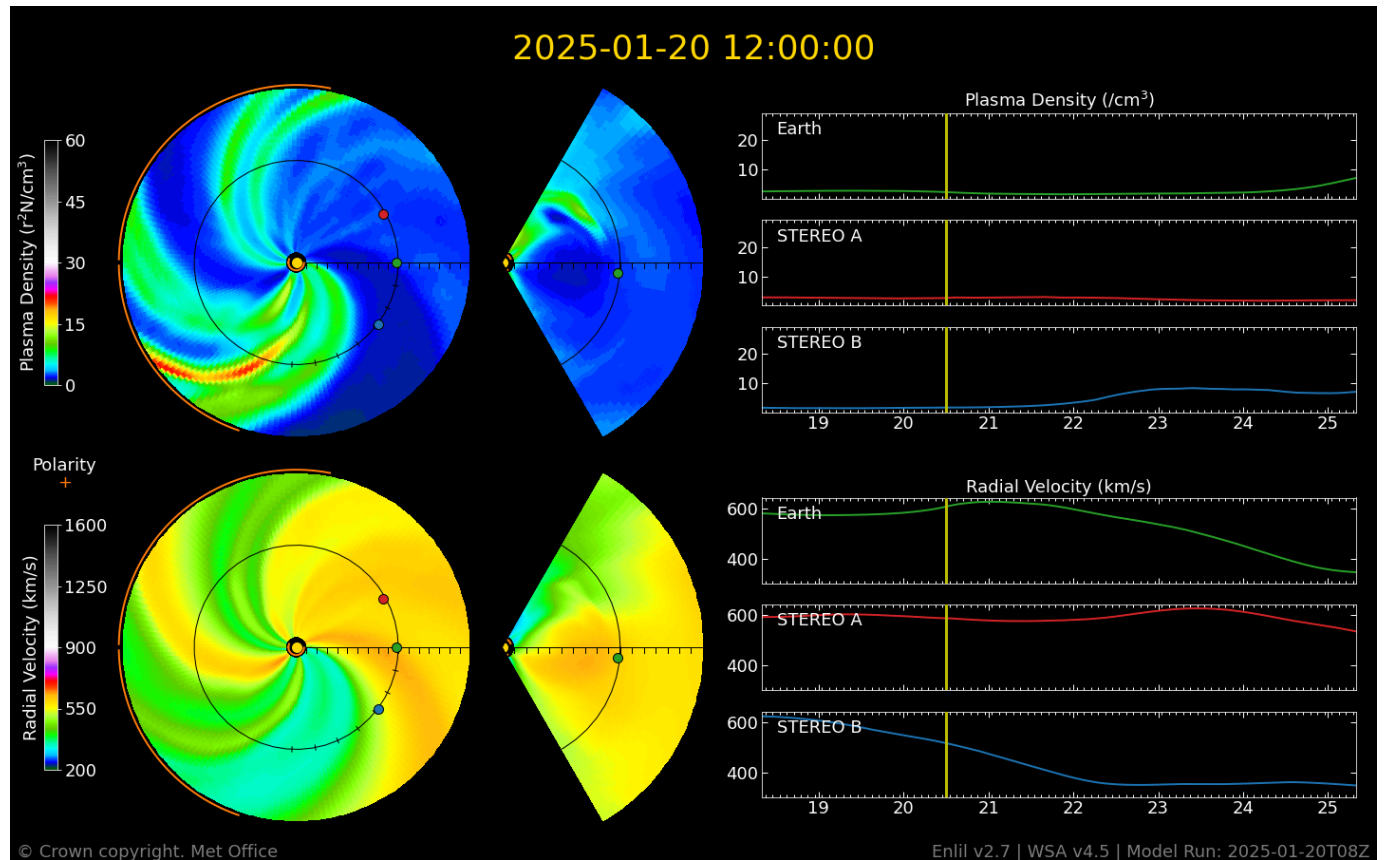
There are no CMEs expected to impact Earth. However a weak eruption from AR3964 early on 18 Jan is expected to pass close to Earth, likely just ahead and north of its orbit. This has a small chance to give a very slight glancing impact late on Day 1 (20 Jan) or early Day 2 (21 Jan), as it passes nearby.

Solar winds are currently dominated by fast wind from the longitudinally wide CH09/-. Observed winds from this feature have increased in recent hours to become strong (with speeds around 600-650km/s). These fast winds are expected to continue on Day 1 (20 Jan), before starting to erratically ease on Day 2 (21 Jan), likely becoming near background by the end of Day 4 (23 Jan). This prolonged enhancement is supported by MOSOWC Enlil, although is now slightly underestimating the strength of the solar wind. Given current observations, its forecast broad decline in the coming days is accepted.

Largely Quiet to Unsettled geomagnetic activity is expected, with a chance of Active intervals. These most likely late on Day 1 or Day 2 (20-21 Jan), mainly if any CME glance occurs.

Geomagnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	10	10	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: Latest MOSWOC Enlil showing connection to HSS of CH09/-. Speeds currently slightly underestimated compared to observed values at L1.



Radio Blackouts - X-Ray Flares

Moderate activity is forecast, with isolated M-class flares expected and a slight chance of X-class flares.

There are twelve sunspot regions on the Earth-facing disc. The largest sunspot, AR3961, is approaching the central meridian in the southern hemisphere. Despite its size, increasing penumbral extent and general consolidation of its spots, it maintains a rather simple magnetic configuration. There is some evidence of a weak delta spot emerging in the interior of the group, but its pre-existing Mount Wilson magnetic type remains as Beta for now. AR3964, a moderately complex group, is becoming increasingly difficult to assess as it approaches the northwest limb, however some slight emergence of small intermediate spots is evident in recent imagery. AR3959 persists as predominately a large leader spot, with a strong magnetic field, but just limited small opposite polarity spots to its east and northeast and a relatively simple magnetic structure. Elsewhere, a cluster of sunspots in the northeast disc, including AR3962 and AR3965, has been split into four separate groups. Individually these appear rather simple, magnetically, but some slow emergence is evident in the area and requires monitoring given the potential for these areas to interact with each other should more substantive growth take place. Minor growth of AR3969 in the southeast has also taken place, but it remains a small bipolar group at this time. The remaining regions on the disc are more magnetically simple at this time.

Of the more significant sunspot regions currently on the disc, AR3964 is the most notable to rotate over the western limb during the period, taking place on Day 3 (22 Jan). Although a number of returning regions are expected in the forecast period, far sided helio-seismic soundings do not currently infer the presence of any strong active regions close to the eastern limb. On balance this means a slight reduction of forecast flare probabilities during the period, independent of any development of the sunspots currently on the facing-disc.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	No	85	85	75	75
Very Active	R3-R5 (X Class)	No	15	15	10	10

Solar Radiation Storms (High Energy Protons)

GOES18 high energy proton flux has persisted at Background levels. There is a slight chance of enhancements exceeding the S1 Minor Radiation Storm threshold should any notable flares occur. This includes any activity from AR3964, which is in a well-connected location in the northwest disc, or from AR3961 near the central meridian in the southern hemisphere. AR3959 in the north, while currently less likely to produce notable flares, has a strong magnetic field suggesting that this is also a potential source should any destabilisation of this region occur.

Radiation Storms	Level (cm ⁻² sr ⁻¹ s ⁻¹)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	15	15	15	15
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = cm ⁻² sr ⁻¹ s ⁻¹)						

High Energy Electrons ($\geq 2\text{MeV}$)

High energy electron flux observed at GOES16 has persisted at mainly Moderate levels as a result of the recent extended period of slightly elevated to elevated solar winds. As these winds ease, any charging of the Radiation Belt at MEO is likely to expand outward, with the diurnal peak period at GEO likely to reach High. However, the longevity of these periods of High flux is currently low confidence due to the lack of any notable geomagnetic activity leading to some uncertainty with the extent of any charging. Furthermore, there is a slight chance of a glancing CME arrival late on Day 1 (20 Jan) or early Day 2 (21 Jan), which could help to drop out the observed flux at GEO.

Subsequently, the associated 24 hr fluence is most likely to stay below the Active ($1\text{e}8$ integrated pfu), but with a very gradual rising trend. MOSWOC REFM supports this rising trend, and is currently giving reasonable guidance.

GEO Electron Environment	Level ($\text{cm}^{-2}\text{sr}^{-1}\text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2\text{ MeV}$ $\geq 1 \times 10^8$	No	1	1	5	5
Very Active	$\geq 2\text{ MeV}$ $\geq 1 \times 10^9$	No	1	1	1	1

Figure 3: Latest MOSWOC REFM indicating Fluence expected to remain below Active threshold during the period.

